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Int J Dev Disabil. Author manuscript; available in PMC 2017 June 16.

Published in final edited form as:

Int J Dev Disabil. 2016 ; 62(3): 147–156. doi:10.1080/20473869.2016.1176308.

Treatment of Escape-Maintained Challenging Behavior Using Chained Schedules: An Evaluation of the Effects of Thinning Positive plus Negative Reinforcement During Functional Communication Training

Amanda N. Zangrillo, **Wayne W. Fisher**, **Brian D. Greer**, **Todd M. Owen**, and **Andresa A. DeSouza**

University of Nebraska Medical Center's Munroe-Meyer Institute

Abstract

Objective—Previous research has supported functional communication training (FCT) as an effective intervention for reducing challenging behavior. Clinicians often program schedule-thinning procedures to increase the portability of the treatment (i.e., reinforcement is provided less frequently). For individuals with escape-maintained problem behavior, chained schedules have proven effective in increasing task completion and supplemental procedures may ameliorate reemergence of challenging behavior as access to reinforcement is decreased. The present study compared the use of a chained schedule-thinning procedure with and without alternative reinforcement (e.g., toys and activities) embedded in an intervention in which escape from the task is provided contingent on a request for a break.

Method—Two individuals with escape-maintained challenging behavior participated. We compared two treatment conditions, escape-only and escape-to-tangibles, using a single-subject, alternating treatments design with each treatment implemented in a distinct academic context.

Results—With the escape-to-tangibles treatment, we reached the final schedule in both contexts with both participants (4 successes out of 4 applications). We did not reach the final schedule with either participant with the escape-only intervention (0 successes out of 2 applications).

Conclusion—The current results provided preliminary confirmation that providing positive plus negative reinforcement would decrease destructive behavior, increase compliance, and facilitate reinforcer-schedule thinning.

Keywords

alternative reinforcement; functional communication training; reinforcer-schedule thinning

In conjunction with functional analysis (FA) of problem behavior, functional communication training (FCT) has become the most commonly implemented treatment for problem behavior reinforced by social consequences (i.e., behavior maintained by access to attention, access to toys, activities and other tangible items, and/or escape from aversive stimuli; Tiger,

Address correspondence to: Amanda N. Zangrillo, Center for Autism Spectrum Disorders, 985450 Nebraska Medical Center, Omaha, Nebraska 68198 (amanda.zangrillo@unmc.edu).

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Hanley, & Bruzek, 2008). Previous research has supported FCT as an effective intervention for reducing a range of topographies of problem behavior, from routine behavior problems to severe destructive behavior (Fisher, Greer, Fuhrman, & Querim, 2015; Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998; Tiger et al., 2008). Carr and Durand (1985) first implemented FCT with four children with developmental disabilities resulting in acquisition of a functional communication response (FCR) for adult attention (e.g., “Am I doing good work?”) and adult assistance (e.g., “I don’t understand”), and a reduction of problem behavior to near-zero levels. Many replications, extensions, and refinements of FCT have been developed since its inception (Tiger, Hanley, & Bruzek, 2008).

FCT procedures include four components. First, the therapist conducts an FA to identify the environmental variables (i.e., functional reinforcers) that maintain problem behavior. Second, the therapist collaborates with caregivers (and the individual, if appropriate) to identify an alternative communication response that is commensurate with the individual’s behavior repertoire (e.g., card touch, American Sign Language, or vocal request). Third, he or she teaches the individual to emit the communication response by prompting the response and delivering the reinforcer identified during the FA as the reinforcer for problem behavior. Lastly, the individual is taught that problem behavior no longer produces the functional reinforcer (i.e., extinction [EXT] is implemented; Fisher et al., 2016).

When FCT is initiated, we deliver reinforcement for the FCR on a dense schedule (e.g., a fixed-ratio 1 [FR-1] schedule in which every FCR produces the functional reinforcer). This arrangement often rapidly reduces challenging behavior to low levels and increases the frequency of the requests. Once the FCR is well established in the individual’s repertoire, the therapist can slowly and systematically thin the schedule of reinforcement in order to make the treatment more portable and practical. Consider the following example: A student engages in aggression and escapes his task demands in class. The teacher teaches the student a FCR (i.e., to exchange a card that says “Break please”), which she reinforces with access to a small break. Other inappropriate forms of accessing a break are placed on EXT and no longer produce escape. The teacher establishes this FCR on a dense schedule of reinforcement (FR 1), meaning that every time the student asks, she provides a break. Over time, the teacher finds that this dense schedule of reinforcement interferes with completely work in a timely way and the schedule of reinforcement must be thinned to a leaner, less frequent schedule. How the schedule is thinned to a practical level while keeping challenging behavior is low is largely dependent on the function of the participant’s challenging behavior and the frequency with which the behavior occurred prior to treatment.

To thin schedules of reinforcement, a multiple schedule that signals periods of time in which the reinforcer is and is not available, has been proven both practical and effective when applied to FCT interventions for individuals with challenging behavior maintained by social-positive reinforcement (e.g., Betz, Fisher, Roane, Mintz, & Owen, 2013). When using a multiple schedule in this way, two distinct signals are presented to the individual, one signaling that engaging in the FCR will result in access to the reinforcer (S+) and the other signaling that engaging in the FCR is will not result in access to the reinforcer (S−; i.e., the FCR is on EXT), and these signals alternate in a time-based manner (e.g., 60 s of reinforcement for the FCR followed by 60 s of EXT for the FCR). In the example above, the

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teacher may place a sign on the chalkboard that says “Break” during periods when the break is available and a sign that says “Work” when EXT is in place. Betz et al., (2013) showed that multiple schedules can facilitate large increases in schedule thinning without resurgence of problem behavior if done systematically.

Another approach to schedule thinning is a response-based format called a chained schedule. With a chained schedule, we require the student to complete work tasks (the initial link signaled by the S−) and when he or she completes that requirement, we switch the S− to the S+, and the individual can obtain the reinforcer by emitting the FCR (the terminal link signaled by the S+). Chained schedules differ from multiple schedules in that termination of the S− component and access to the S+ component occur only after the individual completes the specified response requirement associated with each component, whereas in multiple schedules, termination of the S− component and access to the S+ component occurs only after the passage of time.

Greer et al. (2015) recently summarized the results of 25 consecutive applications of multiple and chained schedules with socially reinforced problem behavior and found that these signaled, compound schedules: (a) produced a 96% reduction in problem behavior at the completion of schedule thinning relative to baseline; (b) maintained the strength of the FCR (with 92% of FCRs occurring in the presence of the S+); (c) reduced the number of reinforcer deliveries for the FCR by 82%; and (d) achieved these improvements without needing to add a punishment component in 96% of applications.

Chained schedules have been found to be most appropriate for problem behavior maintained by social-negative reinforcement because they allow the therapist to gradually increase the amount of work the individual must complete before the S+ is presented and the FCR produces reinforcement (e.g., Fisher et al., 1993; Lalli et al., 1995). If a therapist used a multiple schedule for problem behavior maintained by social-negative reinforcement, the individual might simply wait for the S− interval to elapse without doing anything. In the example listed above, the student may simply sit and wait for the stimulus change to occur without completing any work. In this case the child is not engaging in problem behavior, but is escaping the task at hand and numerous learning opportunities. In the context of a chained schedule, thinning is conducted by systematically increasing the response requirement during the initial link (e.g., the number of compliant responses) before the terminal link becomes available.

Lalli et al. (1995) implemented a chained schedule to increase task completion and decrease escape-maintained problem behavior in three adolescents with developmental disabilities. The participants first learned to emit a verbal response “No” as a request for a break from demands while problem behavior was ignored. Following this initial acquisition phase, the response requirement was gradually increased before the participants could request a break from demands. At the end of the intervention, participants completed a total of 16 tasks before a break became available, while levels of problem behavior remained near zero. Despite the fact that the alternative response provided access to the functional reinforcer, additional procedures may still be needed to decrease problem behavior to acceptable levels during the thinning of a chained schedule.

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For escape-maintained problem behavior, access to escape is referred to as the “functional” reinforcer (e.g., Vollmer, Marcus, & Ringdahl, 1995), and other reinforcers are often referred to as alternative (or arbitrary) reinforcers such as toys or attention (e.g., Harding, Wacker, Cooper, Millard, & Jensen-Kovalan, 1994). Thus, one way to increase the effectiveness of FCT and to avoid the reemergence of challenging behavior as the schedule is thinned is to embed alternative reinforcement during the reinforcement interval (Rooker, Jessel, Kurtz, & Hagopian, 2013). For example, Hagopian, Contrucci Kuhn, Long, and Rush (2005) maintained lower and more stable levels of problem behavior (maintained by social-positive reinforcement) and reached the terminal goal of their intervention more rapidly when they added alternative reinforcers during the period when the FCR was not honored (S−) relative to when nothing was available during the S− period. One limitation of delivering escape on a time-based schedule is that it can decrease learning opportunities. Delivering alternative reinforcement for task completion may be more appropriate in such situations because it increases the reinforcing value of breaks following task completion and potentially reduces the evocative effects of the nonpreferred demands. For example, Piazza, Moes, and Fisher (1996) demonstrated that embedding alternative reinforcers (e.g., attention, tangible items) into the break interval increased compliance and decreased the problem behavior of an 11-year-old boy with an intellectual and developmental disability (IDD). In this study, the therapist delivered prompts (without physical guidance) every 10 s until the participant completed the task. Contingent on compliance with a specified number of tasks, the session ended, and the therapist provided the participant access to a preferred stimulus for 10 min. Schedule thinning continued until the participant completed a total of 28 tasks with low levels of problem behavior before receiving a 10-min break.

Whereas the treatment proved effective in promoting acceptable levels of compliance and problem behavior, the design used by Piazza et al. (1996) did not provide a direct comparison of schedule thinning with and without alternative reinforcers available during the escape interval. Therefore, the conclusions regarding the role of the alternative reinforcement in achieving the terminal-chain schedule and in the rapidity with which the investigators were able to reach that final step remain in question. In the current study, we extended the Piazza et al. study and evaluated the use of a chained schedule with and without preferred items (alternative reinforcement) during the break interval in an intervention for escape-maintained problem behavior.

The primary purpose of this investigation was to provide a direct comparison of two methods of thinning chained schedules of reinforcement for the FCR during FCT with two children who displayed escape-maintained challenging behavior. Specifically, we compared one chained schedule in which the terminal link produced a break from demands with another chained schedule in which the terminal link produced a break from demands plus access to alternative reinforcement (e.g., preferred items). The goal was to determine which schedule would be more effective in extending the schedule of reinforcement while keeping challenging behavior low.

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Method

Subjects and Setting

Two children referred to a day-treatment program for the assessment and treatment of severe aggressive and disruptive behavior and noncompliance participated. We conducted all sessions in a 4-m × 4-m clinic room containing tables, chairs, and relevant session materials (e.g., instructional materials, discriminative stimuli, highly preferred tangible items). Each room included a one-way observation mirror, behind which trained observers recorded data on the target responses.

Cody, a 7-year-old boy with a diagnosis of intermittent explosive disorder and autism spectrum disorder, displayed severe aggression, property destruction, and noncompliance and communicated in full sentences, albeit with some articulation difficulties. Matt, a 7-year-old boy, diagnosed with intermittent explosive disorder and attention deficit-hyperactivity disorder, displayed severe aggression, property destruction, spitting, and noncompliance and communicated using complex sentences.

Response Measurement and Reliability

Dependent variables—Trained observers recorded data using laptop computers to score each challenging behavior, compliant response, and FCR. Challenging behavior included aggression and disruption for both participants and spitting for Matt only. We defined: (a) *aggression* as hitting, kicking, pushing, pulling, grabbing, throwing objects at others, scratching, spitting towards therapist, stepping on therapist's foot, pinching, and head-butting; (b) *disruption* as throwing objects (not at the therapist), hitting or kicking objects, turning over furniture, swiping objects from the table top, and ripping materials; and (c) *spitting* as saliva passing the plane of the lips not directed at the therapist. Functional alternative behaviors included compliance and FCRs. We defined (a) *compliance* as completion of a demand within 5 s of a verbal or modeled prompt and (b) an *FCR* as a vocal request for a break (e.g., "Break please").

We calculated (a) the rate of challenging behavior per session by dividing the total number of challenging responses by the duration of the session in minutes, (b) the percentage of compliance by dividing the total number of compliant responses by the total number of demands in each session and converting the quotient to a percentage, and (c) the rate of correct FCRs per session (during the chained schedules) by dividing the total number of FCRs by the duration of the session in minutes.

Interobserver agreement—A second observer simultaneously, but independently, recorded dependent measures during a portion of the FA and treatment sessions. We partitioned these sessions into successive 10-s intervals for calculating interobserver agreement (IOA). We scored an agreement if both observers recorded the same frequency of the target response in a given interval. We calculated exact agreement coefficients by dividing the number of intervals with agreements by the total number of intervals in a session and converting the quotient to percentage. During the FA, we collected IOA during 41.5% and 42.0% of sessions for Cody and Matt, respectively. For Cody, IOA for

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challenging behavior and compliance averaged 97.6% and 98.2%, respectively. For Matt, IOA for challenging behavior and compliance averaged 97.8% and 98.1%, respectively. During treatment sessions, we collected IOA during 28.0% and 23.5% of sessions for Cody and Matt, respectively. For Cody, IOA for challenging behavior, compliance, and FCRs averaged 98.7%, 92.9%, and 96.4%, respectively. For Matt, IOA for challenging behavior, compliance, and FCRs averaged 99.2%, 92.4%, and 98.5%, respectively.

Procedure

Phase 1: Functional Analysis

Therapists conducted a multielement FA initially with each participant using procedures described by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994), with the addition of a tangible test condition and modifications recommended by Fisher, Piazza, and Chiang (1996). Prior to conducting the FAs, we identified higher and lower preferred tangible items using a paired-choice preference assessment (Fisher et al., 1992), and we identified task demands likely to evoke problem behaviors via caregiver and teacher report. For Cody, sessions initially lasted 5 min, but we subsequently increased session duration to 10 min to increase exposure to the establishing operation for escape from demands following a series of sessions in which he emitted low levels of challenging behavior. For Matt, all sessions lasted 10 min, but we increased task difficulty to increase exposure to the establishing operation for escape from demands following a series of sessions in which he emitted low levels of challenging behavior.

Ignore—The therapist restricted attention. No items were present in the room. This condition was used to evaluate whether automatic reinforcement maintained challenging behavior.

Attention—The therapist provided approximately two min of presession access to attention and a low-preferred item. The therapist diverted attention towards activities such as completing paperwork or reading a magazine. Contingent on challenging behavior, the therapist provided access to attention in the form of verbal reprimands for 30 s. This condition was used to evaluate whether positive reinforcement in the form of access to attention maintained challenging behavior.

Tangible—The therapist provided approximately two min of presession access to the highly preferred item(s), after which the therapist began restricting access to the item(s). Contingent on challenging behavior, the therapist provided access to the tangible item(s) for 30 s. This condition was used to evaluate whether positive reinforcement in the form of access to tangibles maintained challenging behavior.

Escape—The therapist instructed the participant to complete nonpreferred demands using a three-step, progressive-prompting procedure (verbal, model, and/or physical guidance). The therapist delivered praise contingent on compliance with the verbal or modeled prompt. Contingent on challenging behavior, the therapist provided a break (or escape) from the nonpreferred demands for 30 s. This condition was used to evaluate whether negative reinforcement in the form of escape from demands maintained challenging behavior.

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Toy Play—The therapist provided access to highly preferred items and continuous access to attention in the form of spoken and physical attention. Preferred items remained freely available and no demands were issued. This condition was used to serve as a control for the other conditions and little to no challenging behavior was expected to occur.

Functional-analysis results—Figure 1 depicts the FA results for Cody (top panel) and Matt (bottom panel). For Cody, no problem behavior occurred during the first five series of conditions. We then increased session duration to 10 min for three additional series of FA conditions, and he contacted the putative reinforcer at least once in the attention, tangible, and escape conditions. However, in the final phase of the FA, when we implemented a pairwise analysis that included the escape and toy play conditions, we observed high levels of challenging behavior in the escape condition ($M = 1.6$) relative to the toy play (control) condition ($M = 0$). These results suggest that negative reinforcement in the form of escape from demands maintained Cody's challenging behavior.

For Matt, we observed elevated levels of challenging behavior across all test conditions (attention, $M = 0.3$; escape, $M = 1.7$; tangible, $M = 0.6$; and ignore, $M = 0.6$), as well as the control condition (toy play, $M = 0.8$). To address possible issues with carryover between sessions, we conducted a pairwise analysis that included the escape and toy play conditions. Beginning in Session 30 we increased the difficulty of the tasks used in the escape condition, which produced high levels of challenging behavior ($M = 2.7$) relative to the toy play condition ($M = 0$). We also completed a pairwise analysis with the tangible and toy play conditions, and both conditions produced equivocal results (Ms = 0.1 and 0.0 for the tangible and toy play conditions, respectively). Taken together, these results suggest that negative reinforcement in the form of escape from demands maintained Matt's challenging behavior.

Phase 2: Treatment Comparison

Experimental design—We compared the two treatment conditions, escape-only and escape-to-tangibles, using a multielement design with each treatment implemented in a distinct context (described below). In addition, once we determined that one treatment (escape-to-tangibles) produced lower levels of challenging behavior, higher levels of compliance, and more rapid schedule thinning than the other treatment (escape-only), we implemented the more effective treatment in both contexts. This method of comparing two or more interventions is often called an alternating-treatments design (Barlow & Hayes, 1979).

Baseline—Given that both participants displayed challenging behavior reinforced by escape from nonpreferred demands, we conducted the baseline for the treatment analysis using procedures identical to those used in the escape condition from the final condition of the FA.

FCT pretraining—We initiated FCT pretraining following completion of the baseline. We used a vocal FCR (i.e., "Break please.") as the FCR for both participants. During pretraining, the therapist instructed the participant to complete nonpreferred demands using

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a three-step, progressive-prompting procedure (verbal, model, and/or physical guidance). The therapist delivered praise contingent on compliance with the verbal or modeled prompt. Challenging behavior resulted in EXT (i.e., challenging behavior no longer produced escape from demands). FCRs resulted in access to the same reinforcer that was identified to maintain problem behavior in the FA (i.e., the FCR resulted in 30 s of escape from demands). To teach the FCR, we used a progressive, prompt-delay procedure. Initially, the therapist provided a prompt as soon as the nonpreferred tasks began (0-s delay) by modeling the words “Break please.” If the participant said “Break please,” either immediately following the modeled prompt or any time thereafter, the therapist provided a 30-s break from the tasks (i.e., the therapist removed the work materials, discontinued instructions and verbal interactions) and then reinitiated the nonpreferred tasks after the reinforcement interval elapsed.

Pretraining sessions continued with the prompt delay set at 0 s until we observed at least an 80% reduction in challenging behavior from baseline levels for two consecutive sessions. Once the participant met this criterion, the therapist introduced a 2-s delay between initiating the nonpreferred demands and the modeling the prompt. Each time we observed an 80% reduction in challenging behavior at a given prompt delay, we increased the prompt delay by 5 s. Once the participant successfully met mastery criterion at the 10-s prompt delay, we terminated the FCT pretraining sessions and initiated schedule thinning using a chained schedule. We did not include the data from the FCT pretraining sessions in this manuscript, but the first author will provide these data upon request.

Contexts for schedule thinning—For both participants, we conducted FCT and schedule thinning in two separate contexts. The therapist wore a colored smock (e.g., yellow) and presented the demands using like-colored materials (e.g., yellow worksheets) on a like-colored placemat (e.g., yellow) in one context and used a different color (e.g., green smock, worksheets, and placemat) in the other context. Prior to each session, the therapist stated the rules for the session, which included specifying the contingencies that were in effect when the S− (work) and S+ (break) cards were in place. In both conditions, the therapist instructed the participant to complete nonpreferred demands using a two-step, progressive-prompting procedure (verbal followed by physical guidance if needed).

General FCT procedure—Following the FCT pretraining, we implemented FCT using a chained schedule. We signaled the components of the chained schedule using 15-cm × 20-cm cards (i.e., a card with the word “Work” on it for the S− and a card with the word “Break” on it as the S+). The S− signaled the first component of the chained schedule, and the participants’ completion of a prespecified work requirement resulted in replacing the S− with the S+. The participants’ emission of the FCR in the presence of the S+ produced reinforcement. Initially, we set the response requirement for the S− component at a single compliant response (i.e., FR 1), and the S+ lasted 30 s in both conditions. Thereafter, we thinned the schedule of reinforcement by gradually increasing the work requirement and lengthening the reinforcement interval until the chained schedule approximated the expectations of the participants’ school programs (i.e., 10 min of work followed by a 5-min break).

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Escape-only condition—The therapist delivered brief praise following each compliant response, and once the participant completed the current response requirement for the S− component of the chained schedule, the therapist removed the S− and replaced it with the S +. If the participant emitted the FCR (i.e., said “Break please”), the therapist terminated the demands and provided the participant with a 30-s break from work (i.e., the therapist removed the academic materials from the table, did not interact with the participant). After this 30-s break, the therapist replaced the S+ with the S− and resumed issuing prompts to complete the work tasks. During both the S− and S+ components, challenging behavior produced no programmed consequence (i.e., EXT).

Escape-to-tangibles—We conducted treatment in a manner identical to that described above, except that we delivered a 30-s break (i.e., the therapist removed the academic materials from the table and did not interact with the participant) *and* provided access to preferred tangible items (e.g., iPad or toy cars) contingent on the participant’s emission of the FCR during the S+ component of the chained schedule.

Schedule thinning in each condition—As indicated above, the initial chained schedule consisted of an FR 1 for compliance, which produced the switch from the S− to the S+, followed by an FR 1 for the FCR, which produced a 30-s break from work (FR 1-FR 1 [30]). Thereafter, we increased the work requirement during the S− component and periodically increased the duration of the reinforcement interval after several (e.g., 2 to 3) sessions with high levels of compliance (at least 80% or higher) and low levels of challenging behavior (at least 80% below the baseline mean). For Cody, we increased the work requirement according to the following progression: FR 1-FR 1 (30); FR 2-FR 1 (30); variable ratio (VR) 5-FR 1 (30); VR 10-FR 1 (30); VR 20-FR 1 (60); VR 40-FR 1 (120); fixed time (FT) 600-FR 1 (300). Based on clinical judgment, we increased the work requirement during the S− component for Matt more slowly. We used the following progression: FR 1-FR 1 (60); FR 2-FR 1 (60); FR 3-FR 1 (60); FR 4-FR 1 (60); FR 5-FR 1 (60); FR 6-FR 1 (60); FR 7-FR 1 (60); FR 8-FR 1 (60); FR 9-FR 1 (60); VR 10-FR 1 (60); VR 20-FR 1 (140); VR 40-FR 1 (300); FT 600-FR 1 (300).

In addition, for Cody only, we added a differential reinforcement of other behavior (DRO) component in which we switched from the S− to the S+ component only if Cody completed the requisite number of tasks without problem behavior. We added the DRO after 10 treatment sessions in the escape-to-tangibles condition and after 12 treatment sessions in the escape-only condition.

We switched to a variable schedule when the work requirement reached 5 compliant responses for Cody and 10 compliant responses for Matt so that future increases in the work requirement would be less discriminable to the participants. In addition, we switched from a VR requirement to a FT schedule of work in the final schedule to align more closely with each participant’s school environment. Similarly, we implemented additional modifications to further approximate the school environment including increasing the variety of tasks implemented and independent work opportunities for Cody and Matt, respectively.

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Results

During FCT pretraining, both participants rapidly learned to independently emit the FCR (data available upon request). Figure 2 depicts the results of treatment and schedule thinning for Cody. In baseline, Cody displayed elevated rates of challenging behavior (M = 3.4) and low levels of compliance (M = 9.1%). Following baseline, we implemented the escape-to-tangibles (top panel) and escape-only (bottom panel) conditions. In the escape-to-tangibles condition, Cody emitted relatively low rates of challenging behavior throughout schedule thinning (M = 0.4). In addition, he displayed high levels of compliance (M = 95.2%) and moderate rates of FCRs (M = 0.6). Cody reached the terminal fading goal in the 24th treatment session in the escape-to-tangibles condition. By contrast, in the escape-only condition, Cody displayed lower rates of challenging behavior (M = 1.9) relative to baseline, but higher rates relative to the escape-to-tangibles condition. Similarly, compliance increased in the escape-only condition (M = 84.7%) relative to baseline, but remained lower than levels in the escape-to-tangibles condition. Approximately twice the number of FCRs were observed in the escape-only condition (M = 1.7) relative to the escape-to-tangibles condition. Finally, schedule thinning progressed more slowly in the escape-only condition relative to the escape-to-tangibles condition, reaching only the fourth step (VR 10-FR 1 [30]) after 37 treatment sessions. We then implemented the escape-to-tangibles treatment at the terminal schedule in the context associated with the escape-only condition, and Cody's challenging behavior, compliance, and FCRs were similar to levels observed in the other context (see the last phase in the bottom panel of Figure 2).

Figure 3 depicts the results of treatment and schedule thinning for Matt. In baseline, Matt displayed elevated rates of challenging behavior (M = 3.3), and he did not comply with any instructions (M = 0.0%). Following baseline, we implemented the escape-to-tangibles (top panel) and escape-only (bottom panel) conditions in each respective context. In the escape-to-tangibles condition, Matt emitted relatively low, but variable rates of challenging behavior (M = 0.3) throughout schedule thinning. In addition, he displayed relatively high levels of compliance (M = 94.8%) and moderate rates of FCRs (M = 0.2) during schedule thinning. Matt met the terminal fading goal following 44 treatment sessions in the escape-to-tangibles condition.

In the escape-only condition, Matt emitted lower rates of challenging behavior (M = 1.0) relative to baseline, but slightly higher rates than in the escape-to-tangibles condition. In addition, he displayed relatively high, but variable levels of compliance (M = 72.0%). Approximately twice the number of FCRs were observed in the escape-only condition (M = 0.5) relative to the escape-to-tangibles condition throughout schedule thinning. However, Matt progressed through the schedule-thinning steps much more slowly in the escape-only condition (only reaching the seventh of 13 steps after 27 sessions) relative to the escape-to-tangibles condition (reaching the seventh step in 23 sessions and completing all of the steps in 46 sessions). Therefore, we then implemented the escape-to-tangibles treatment with Matt in the other context, and his challenging behavior decreased and his compliance increased (see the last phase in the bottom panel of Figure 3). We implemented the terminal schedule of FT 600-FR 1 (300), and Matt emitted levels of challenging behavior, compliance, and FCRs similar to levels observed in the first context.

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Finally, Figure 4 shows the cumulative number of compliant responses for Cody (top panel) and Matt (bottom panel) emitted during the escape-to-tangibles and escape-only conditions. As can be seen, Cody completed almost twice as much work in the escape-to-tangibles condition relative to the escape-only condition (i.e., with the amount of work operationally defined as the cumulative number of compliant responses). Matt showed more moderate differences, but he still completed about 1.5 times as much work in the escape-to-tangibles condition relative to the escape-only condition.

Discussion

In this investigation, we developed and compared two FCT interventions for two children who displayed challenging behavior reinforced by escape from nonpreferred demands. With both treatments, we thinned the reinforcement schedule using chained schedules of reinforcement in which we presented discriminative stimuli to signal when we required the participant to complete work tasks (signaled by the S−) and when they could obtain a break from those work tasks by emitting the FCR (signaled by the S+). In one treatment, we delivered only a break following emission of the FCR, and in the other, we delivered a break and access to a preferred tangible item(s). Results showed that the escape-to-tangibles treatment produced lower levels of problem behavior, higher levels of compliance, and more rapid reinforcer-schedule thinning relative to the escape-only treatment. These findings extend the literature on the treatment of negatively reinforced problem behavior in several potentially important ways.

First, Piazza and colleagues (Piazza et al., 1996; 1997) demonstrated that combining positive and negative reinforcement in function-based, differential-reinforcement interventions often produced reductions in negatively reinforced problem behavior, increases in compliance, and sometimes rendered extinction of problem behavior unnecessary. In the current investigation, we replicated the beneficial effects of combining positive and negative reinforcement for the FCR during FCT for decreasing negatively reinforced challenging behavior and for increasing compliance. We are also extending this line of research by showing that combining positive and negative reinforcement in the treatment of negatively reinforced challenging behavior also facilitated more rapid and complete reinforcer-schedule thinning. That is, with the escape-to-tangibles treatment, we reached the final schedule (10 min of work followed by a 5-min break) in both contexts with both participants (4 successes out of 4 applications), whereas we did not reach the final schedule with either participant with the escape-only intervention (0 successes out of 2 applications).

Subsequent to the work of Piazza et al. (1996; 1997), researchers have attempted to determine the operant mechanism responsible for the beneficial effects of reinforcing appropriate alternative responses with positive reinforcers when treating problem behavior reinforced by escape from nonpreferred tasks. For example, Lalli et al. (1999) showed that positive reinforcement of compliance reduced negatively reinforced challenging behavior and increased compliance without the use of EXT in a series of five participants. They suggested two possible operant mechanisms for these impressive results. One possibility was that their experimental preparation placed the two reinforcers (positive reinforcement for compliance; negative reinforcement for challenging behavior) in direct competition, and the

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participants chose the positive reinforcer (by emitting compliance) over the negative reinforcer (by not emitting challenging behavior). A second possibility proffered by Lalli et al. was that the presentation of positive reinforcement for compliance acted as an abolishing operation that reduced the participants' motivation to escape the demands by displaying challenging behavior.

Lomas, Fisher, and Kelley (2010) directly tested this second hypothesis by delivering positive reinforcers (i.e., edible items and praise) on a time-based schedule while continuing to provide escape for challenging behavior. Results showed that the time-based delivery of positive reinforcers acted as an abolishing operation and reduced challenging behavior to near-zero levels in a series of three participants. Future research should replicate the current schedule-thinning procedures using time-based schedules of reinforcement (rather than differential reinforcement) to determine whether the abolishing effects of delivering positive reinforcers during nonpreferred demands is maintained as individuals with negatively reinforced challenging behavior are required to complete progressively more work during schedule thinning.

The current findings also extend the results reported by Hagopian et al. (2005) who showed that delivery of competing items (i.e., alternative positive reinforcers) facilitated reinforcer-schedule thinning for three participants who displayed problem behavior maintained by other sources of positive reinforcement. Our results extend these findings by showing that the delivery of alternative positive reinforcers also facilitated reinforcer-schedule thinning when the goal is not only to lean the schedule of reinforcement while maintaining low levels of challenging behavior, but also to have individuals complete increasing amounts work (compliance with nonpreferred tasks) during the periods in which the FCR does not produce reinforcement.

Another extension of the current investigation is that we showed the accrued benefits of combining positive and negative reinforcement in the treatment of negatively reinforced challenging behavior and noncompliance in terms of cumulative amount of work completed by the participants. As indicated above, both participants completed substantially more work in the escape-to-tangibles condition relative to the escape-only condition. Future researchers may wish to use behavioral-economics procedures to evaluate the relative-reinforcement value of combining positive and negative reinforcers versus either of these two classes of reinforcers in isolation (Roane, 2008).

The findings and implications of the current results should be interpreted relative to several limitations of the current investigation. First, the study involved just two participants, and though each one showed the same general pattern of results, Cody showed more robust differences between the escape-to-tangibles and the escape-only conditions than did Matt. Thus, future studies should replicate the current results with a larger number of participants to better account for individual variability in treatment response. A second limitation of the study is that we did not conduct reversals in which we reintroduced the baseline condition to clearly demonstrate that both interventions reduced challenging behavior relative to baseline. For the escape-to-tangibles condition, this limitation is mitigated considerably by the fact that we introduced this intervention four times (into both contexts for each of the two

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participants), and each time it was introduced, we observed decreases in challenging behavior and concomitant increases in compliance. Nevertheless, future researchers should consider conducting a reversal to baseline to more definitively establish the effectiveness of each of the two interventions.

In summary, we evaluated the effects of combining positive and negative reinforcement during reinforcer-schedule thinning for FCT using chained schedules when treating challenging behavior reinforced by escape from nonpreferred demands. We hypothesized that providing positive plus negative reinforcement following completion of the chained schedule would decrease challenging behavior, increase compliance, and facilitate reinforcer-schedule thinning. The current results provided preliminary confirmation of this multicomponent hypothesis.

Acknowledgments

This research was supported in part by Grants #5R01HD079113-02 and #1R01HD083214-01 from The National Institute of Child Health and Human Development.

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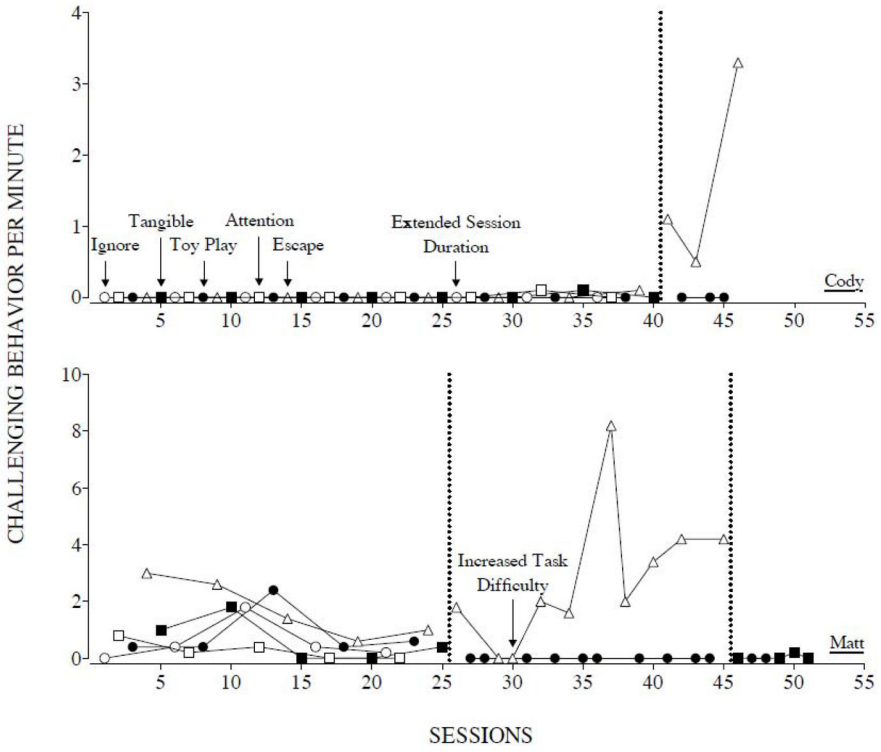

Figure 1.
Rate of challenging behavior during the functional analysis for Cody (top panel) and Matt (bottom panel).

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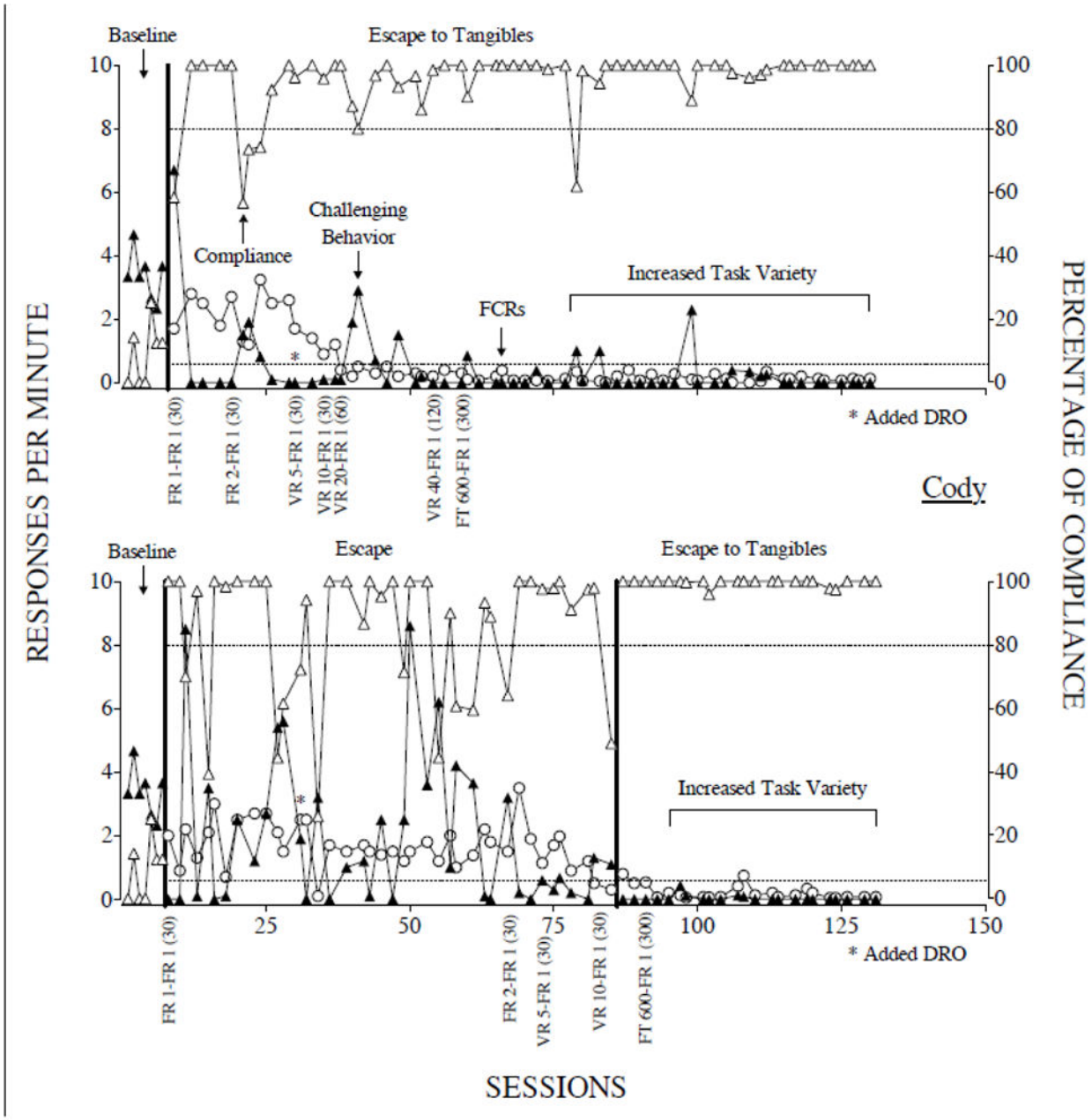

Figure 2.

Rate of challenging behavior, functional communication responses, and percentages of compliance during baseline and both treatment conditions for Cody. Escape to tangibles and escape are depicted in the top and bottom panels, respectively. Horizontal lines depict the fading criteria for challenging behavior (90% below the baseline mean for Cody) and compliance (80%). The asterisk denotes the addition of a differential-reinforcement-of-other-behavior procedure.

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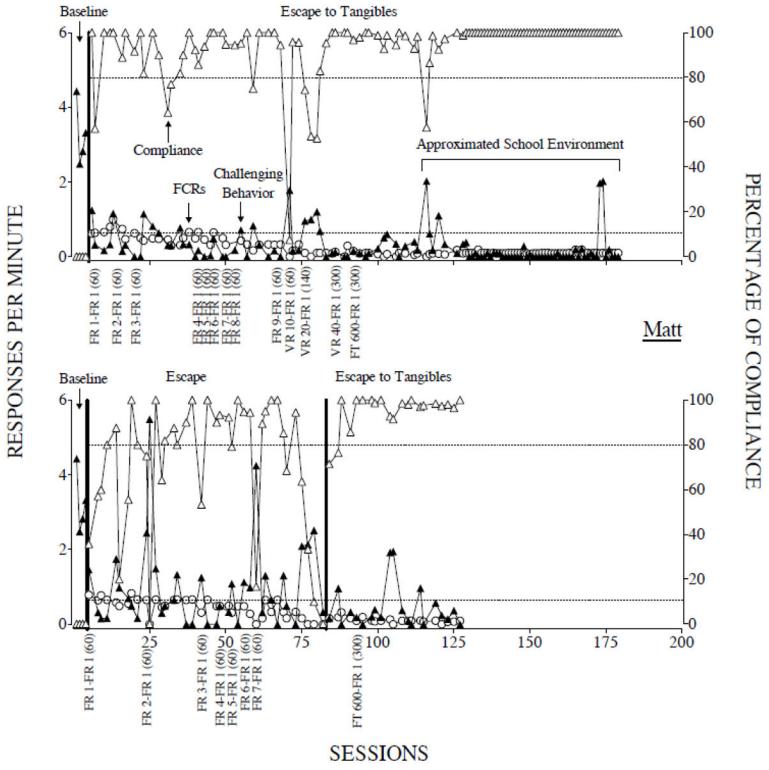

Figure 3.

Rates of challenging behavior, functional communication responses, and percentages of compliance during baseline and both treatment conditions for Matt. Escape to tangibles and escape are depicted in the top and bottom panels, respectively. Horizontal lines depict the fading criteria for challenging behavior (80% below the baseline mean for Matt) and compliance (80%). The asterisk denotes the addition of a differential-reinforcement-of-other-behavior procedure.

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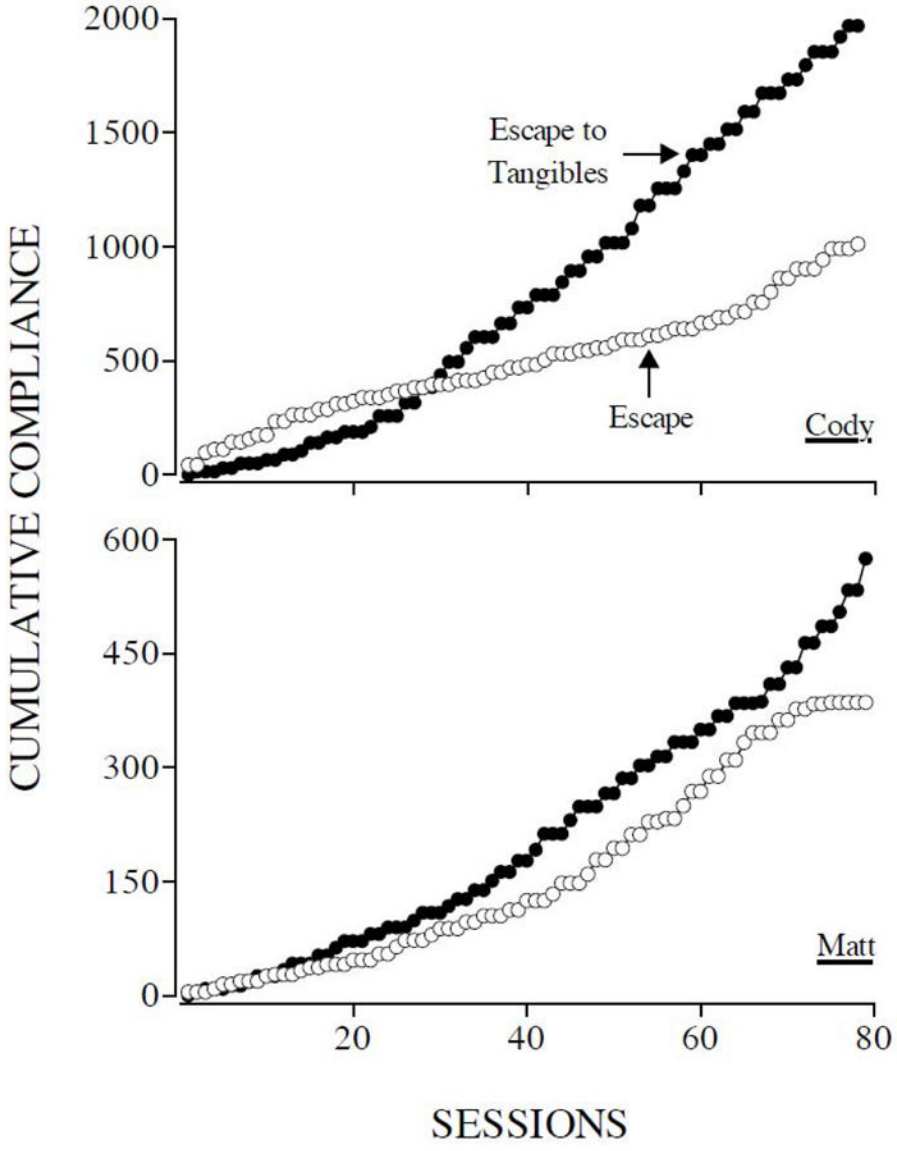

Figure 4.
Cumulative number of compliant responses for Cody (top panel) and Matt (bottom panel) emitted during the escape-only and escape-to-tangible conditions.